

Appl. No. 10/673,640  
Amdt. Dated September 14, 2005  
Reply to Office Action of March 16, 2005

Attorney Docket No. 81788.0258  
Customer No.: 26021

Amendments to the Drawings:

The attached sheet of drawings includes changes to FIGS. 8 and 9. This sheet, which includes FIGS. 8 and 9, replaces the original sheet including FIGS. 8 and 9. FIGS. 8 and 9 have been labeled as Prior Art as requested by the Examiner.

Attachment: Replacement Sheet  
Annotated Sheet Showing Changes

**REMARKS:**

This is in response to the Office Action dated March 16, 2005. Pursuant to this amendment, claims 1-20 are pending. Reexamination and reconsideration are respectfully requested.

Applicant amends claims 1 and 8 to broaden these claims. Applicant amends claims 3 and 10 to correct a typographic error; this amendment does not affect the scope of these claims.

The Office Action objects to the drawings. Applicant attaches a sheet of drawings including changes to FIGS. 8 and 9. This sheet, which includes FIGS. 8 and 9, replaces the original sheet including FIGS. 8 and 9. FIGS. 8 and 9 have been labeled as prior art as requested by the Examiner.

The Office Action rejects claims 1-13 over the art illustrated in FIGS. 8 and 9 of the application as modified by U.S. Patent No. 6,693,306 to Chen, et al. (the Chen patent). Applicant submits that the art illustrated in FIGS. 8 and 9 and the Chen patent does not render obvious the present invention.

The application describes a more efficient LED. As illustrated in FIGS. 1 and 2, the application's LED includes a substrate 101 having a cross sectional area larger than a number of epitaxial layers, including active layer 105, bonded to substrate 101. The illustrated LED structure results in a more efficient LED, without having the higher operating voltage that would conventionally be expected. This smaller cross sectional area is recited in independent claims 1 and 8. The Office Action indicates that the claimed structure is not described in the prior art. Rather, the Office Action indicates that the claimed structure would have been obvious in light of the conventional LED illustrated in application FIGS. 8 and 9 as modified in light of the Chen patent. Applicant submits that the claims would not

have been obvious over the proposed combination of references, which describe incompatible electrode structures that would not be combined.

FIGS. 8 and 9 of the application illustrate a conventional LED configuration in which a set of epitaxial layers are bonded to a *conductive* p-type gallium phosphide substrate 501. N-type diffusion layer 507 is formed on the opposite side of the set of epitaxial layers. Electrodes 510 and 511 are formed on opposite ends of the LED so that current flows vertically through the device of FIG. 8. As illustrated most clearly in FIG. 8, the epitaxial layers of the illustrated LED have the same cross-section area as the substrate 501.

The Chen patent describes a different and incompatible structure for an LED. As best shown in FIG. 2 of the Chen patent, the diode is formed on an *insulating* sapphire substrate 10. Because the sapphire substrate 10 is insulating, conductive n-type layer 20 is provided on the surface of the sapphire substrate 10 and subsequent layers 40, 60, are formed on that n-type layer 20. Conductive n-type layer 20 is required to make contact to layer 40. Electrode 80 is formed on the p-type layer 60 and electrode 70 is formed on the n-type layer 20. In contrast to the LED illustrated in FIGS. 8 and 9, the LED illustrated in the Chen patent does not provide electrodes on opposite sides of the LED. In fact, it would be impossible to provide electrodes on opposite sides of the LED illustrated in the Chen patent. This is because the substrate 10 of the Chen patent's LED is insulating sapphire.

As shown in FIGS. 1 and 2 of the Chen patent, layers 40 and 60 have a smaller cross-section area than the substrate 10. This is to allow room for a contact to the n-type side (including layer 20) of the Chen patent's LED to be formed. There is no reason to use the contact structure, 20 and 70 of the Chen patent if the LED is formed on a conductive substrate rather than the insulating substrate 10 of the Chen patent. If the insulating substrate 10 of the Chen patent is not used, one of

ordinary skill in the art would place the electrode for the LED on the more desirable conductive substrate (such as is used in application FIGS. 8 and 9). Thus, the normal thing to do with the LED of application FIGS. 8 and 9 in view of the Chen patent is to reject the Chen patent's electrode structure as not useful.

The LED shown in application FIGS. 8 and 9 uses electrodes 510, 511 on opposite sides of the LED. This is an easier to manufacture structure than that illustrated in the Chen patent. Because the LED of application FIGS. 8 and 9 uses a conductive substrate 501, there is no reason to extend any layer laterally to form a contact electrode to the LED. Rather, it is preferable to form one of the electrodes on the conductive substrate. Consequently, the LED of FIGS. 8 and 9 *would not* be modified in light of the teachings of the Chen patent. Rather, the inconvenient structure of the Chen patent would be rejected in favor of the more easily made structure of the LED of FIGS. 8 and 9.

The Office Action provides no support for its incorrect statements regarding why the LED of application FIGS. 8 and 9 would be modified in light of the Chen patent. The Office Action states at page 4 that it would have been obvious to modify the LED of application FIGS. 8 and 9 "to lower the amount of supplied current to the structure." Applicant finds no support for this supposition; moreover, there is no reason to conclude that such would actually be true. The Chen patent uses a more restricted (narrower) contact structure and so would usually be expected to be more resistive, with less current flow, than the larger cross section contact structure of the LED of application FIGS. 8 and 9. Because there is no support for the stated reason for combining these references and because this stated justification appears not to be true, applicant submits that it would not have been obvious to modify the LED of application FIGS. 8 and 9 in view of the Chen patent.

Because the stated reason for modifying the LED of application FIGS. 8 and 9 lacks factual support and is most likely incorrect, the proposed combination would not have been obvious and the claims pending in the application are allowable over the art of record.

The Office Action rejects claims 2, 5-6, 9 and 12-13, stating that the prior art fails to disclose that providing an epitaxial growth layer smaller than the substrate by not less than 60% and not more than 90% but that these limitations would have been obvious and would have been derived by "routine optimization." The Office Action states that the not less than 60% and not more than 90% limitations may impart patentability to claims 2, 5-6, 9 and 12-13 if applicant shows that the claimed ranges are "critical." Applicant respectfully submits that this statement is contrary to controlling law, which states that it would not have been obvious to vary a parameter to achieve a claimed invention, because the prior art did not recognize that the parameter was a "result-effective variable." *In re Antonie*, 559 F.2d 618, 620, 195 USPQ 6, 8-9 (CCPA 1977).

Applicant submits that claims 2, 5-6, 9 and 12-13 would not have been obvious over the admitted prior art taken in view of the Chen patent because the prior art does not identify the area of the epitaxial region as a result effective variable. *See id.* In particular, the Chen patent does not suggest that the relative size of the epitaxial layer has any effect on the performance of an LED. Consequently, claims 2, 5-6, 9 and 12-13 distinguish over the prior art of record and are in condition for allowance.

Moreover, the application shows the unexpected results of reducing the cross-sectional area of the epitaxial layers. As discussed starting at page 12, line 5 through page 14, line 10, the application explains that the diode unexpectedly does not exhibit increased operating voltage  $V_f$  and unexpectedly has improved efficiency

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without increased operating voltage. Consequently, applicant has demonstrated the non-obviousness of claims 2, 5-6, 9 and 12-13 and these claims distinguish over the cited record for this additional reason.

In view of the foregoing, it is respectfully submitted that the application is in condition for allowance. Reexamination and reconsideration of the application, as amended, are requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California telephone number (310) 789-5100 to discuss the steps necessary for placing the application in condition for allowance.

If there are any fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,

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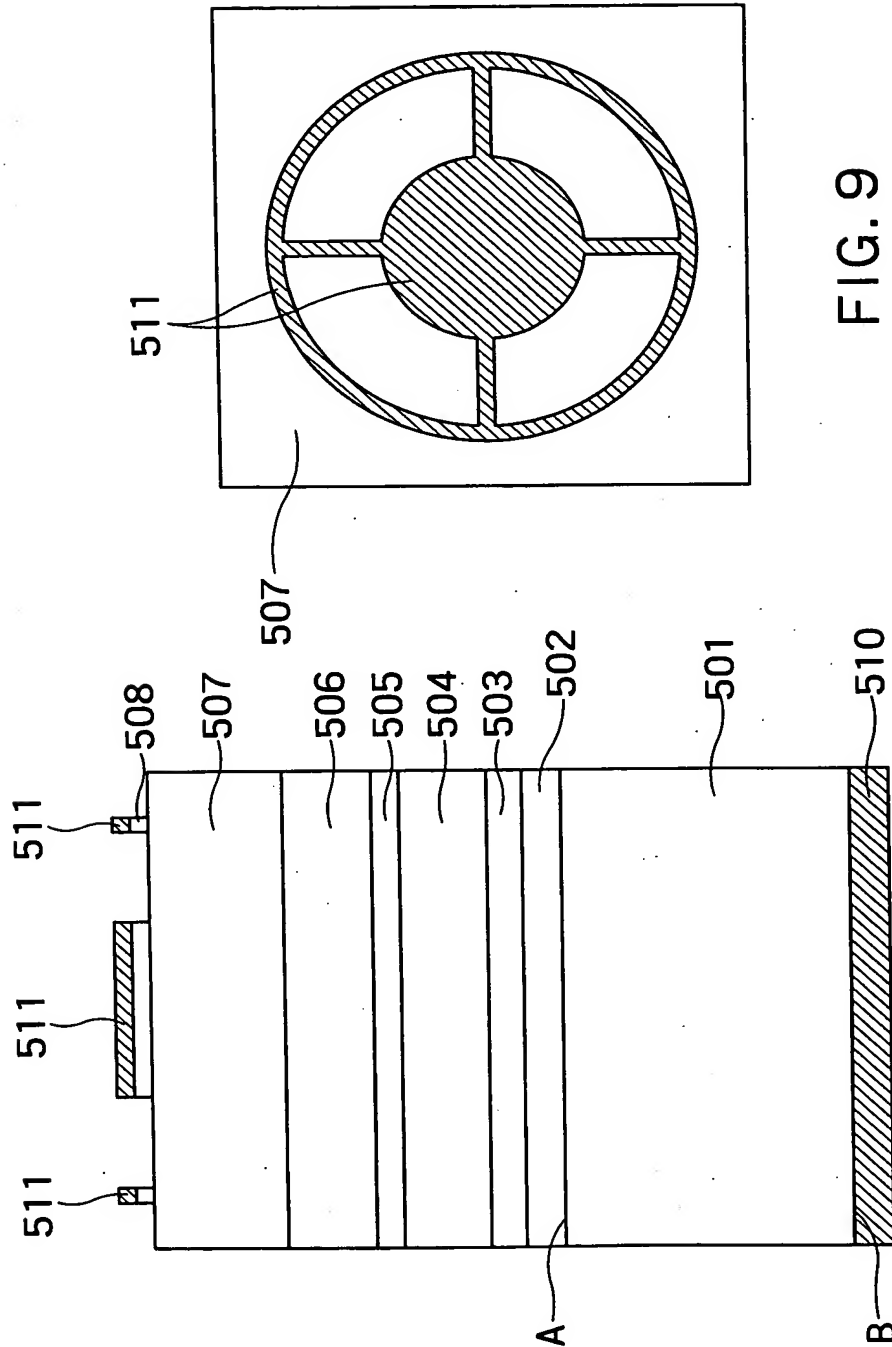


FIG. 8

Prior Art

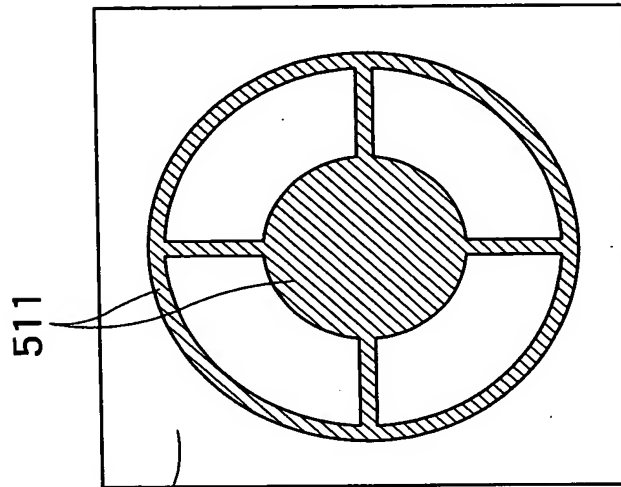


FIG. 9

Prior Art